DGH TECHNOLOGY, INC.
DGH 9000
DGH 9000 PHACO
SERVICE MANUAL

DGH TECHNOLOGY, INC.
110 Summit Drive
Exton, PA 19341
(610) 594-9100
(610) 594-0390 FAX

IMPORTANT NOTICE

COMMENTS ON, OR CORRECTIONS TO THIS MANUAL SHOULD BE ADDRESSED TO:
DGH TECHNOLOGY, INC., TECHNICAL SUPPORT
23042 ALCALDE, SUITE A
EXTON, CA 92653

SERVICE MANUAL REVISION RECORD

LIST OF EFFECTIVE PAGES

WHEN RECEIVING UPDATES TO THIS SERVICE MANUAL, PLEASE STAPLE THE UPDATED PAGE OVER THE RESPECTIVE EXISTING PAGE.

PAGE NO.	CHANGE NO.	CHANGE DATE

LIST OF ILLUSTRATIONS

PRODUCT INFORMATION

CONTENTS

THIS MANUAL IS DIVIDED INTO FIVE (5) SECTIONS. SECTION ONE PROVIDES INFORMATION ON THE PRODUCT AND ITS USE. SECTION TWO PROVIDES PROCEDURES FOR EVALUATION OF THE PRODUCT TO VERIFY THAT ALL SYSTEMS ARE FUNCTIONAL. SECTION THREE PROVIDES THEORY OF OPERATION FOR THE OVERALL SYSTEM AND THE FUNCTIONAL ASSEMBLIES. SECTION FOUR PROVIDES PROCEDURES FOR THE ROUTINE MAINTENANCE OF THE PRODUCT. SECTION FIVE PROVIDES DOCUMENTS AND PROCEDURES NECESSARY FOR SERVICING THE PRODUCT.

MANUAL INTENT

IT IS THE INTENT OF THIS MANUAL TO PROVIDE INFORMATION ON THE USE, MAINTENANCE AND SERVICE OF THE PRODUCT. THE MANUFACTURER MAINTAINS FACILITIES FOR THE IMMEDIATE SERVICING AND REPAIR OF THIS PRODUCT, AND RECOMMENDS THAT THE PRODUCT BE RETURNED TO THE MANUFACTURER FOR SERVICE AND REPAIR. THE PRODUCT CONTAINS NO USER SERVICEABLE COMPONENTS, AND IN ALL CASES, ONLY QUALIFIED PERSONNEL SHOULD ATTEMPT SERVICE AND REPAIR.

ASSOCIATED DOCUMENTS

INFORMATION NECESSARY FOR THE PROPER USE OF THIS PRODUCT IS CONTAINED IN THE DOCUMENT: “DGH TECHNOLOGY, INC. DGH 9000 DGH 9000 PHACO OPERATOR’S MANUAL P/N 897182”. THIS DOCUMENT IS SUPPLIED WITH EACH SURGICAL SYSTEM. COMPLETE INFORMATION FOR THE CLEANING AND STERILIZATION OF THE ULTRASONIC (U/S) HANDPIECE IS PROVIDED IN THE DOCUMENT: “CLEANING AND STERILIZATION, U/S HANDPIECE P/N 897100”. THIS DOCUMENT IS SUPPLIED WITH EACH U/S HANDPIECE. ADDITIONAL COPIES OF THESE DOCUMENTS ARE AVAILABLE FROM THE MANUFACTURER FOR A NOMINAL CHARGE.

PRODUCT DESCRIPTION

THE DGH 9000 DGH 9000 PHACO (DGH 9000) IS A SOPHISTICATED SURGICAL TOOL DESIGNED FOR OPHTHALMIC SURGEONS. IT IS INTENDED TO BE USED ONLY BY THOSE SURGEONS FAMILIAR WITH EXTRACAPSULAR CATARACT EXTRACTION (ECCE), AND/OR PHACOEMULSIFICATION (PHACO). IT IS DESIGNED AND MANUFACTURED TO BE RELIABLE, SAFE AND EASY TO OPERATE.

THE DGH 9000 IS DESIGNED TO PROMOTE OPERATOR SAFETY WHEN USED PROPERLY. THE DGH 9000 CONFORMS TO THE STANDARDS SET FORTH BY UNDERWRITERS LABORATORIES INC. FOR MEDICAL AND DENTAL EQUIPMENT (UL544).

THE COMPLETE DGH 9000 CONSISTS OF THE COMPONENTS SHOWN IN FIGURE 1, PAGE 8 OF THE OPERATOR'S MANUAL P/N 897182**,** WHICH ARE THE CONSOLE, THE FOOTPEDAL AND THE POWER CORD. THE MANUFACTURER ALSO SUPPLIES THE U/S HANDPIECE ILLUSTRATED. ALSO SHOWN ARE ACCESSORIES AND DISPOSABLES NOT NORMALLY SUPPLIED BY THE MANUFACTURER. EXCEPT FOR THE DISPOSABLES, THE USER HAS SIGNIFICANT FREEDOM IN CHOOSING THE ACCESSORY THAT BEST SUITS HIM. THE USER SHOULD CONTACT HIS SALES REPRESENTATIVE FOR FURTHER INFORMATION CONCERNING THE COMPATIBILITY, SUITABILITY AND AVAILABILITY OF ALL ACCESSORIES. PAGE 13 OF THIS MANUAL CONTAINS A LIST OF ACCESSORIES RECOMMENDED BY THE MANUFACTURER AS BEING FULLY COMPATIBLE WITH THE DGH 9000.

THE DGH 9000 IS AN OPHTHALMIC SURGICAL INSTRUMENT FOR ECCE. THE OPHTHALMIC SURGEON HAS THE CHOICE TO REMOVE THE NUCLEUS FOR THE EYE MANUALLY, OR TO EMULSIFY THE NUCLEUS WITH PHACO. FOLLOWING THE ECCE, THE DGH 9000 ASPIRATES CATARACTOUS AND/OR CORTICAL MATERIAL FROM THE EYE. A RELATIVELY CONSTANT INTROCULAR PRESSURE (IOP) IS MAINTAINED THROUGH THE INFUSION OF A STERILE SOLUTION, SUCH AS BASIC SALT SOLUTION (BSS). IOP IS ADJUSTED BY RAISING/LOWERING THE IRRIGATION SOLUTION CONTAINER.

THE DGH 9000 PROVIDES VITRECTOMY (VIT) CAPABILITY TO CUT AND ASPIRATE VITREOUS WHEN REQUIRED BY THE SURGICAL PROCEDURE. CAUTERY IS PROVIDED TO CAUTERIZE BLOOD VESSELS THAT HAVE BEEN SEVERED BY THE SURGICAL PROCEDURE.

SPECIFICATIONS

FUNCTIONAL SPECIFICATIONS

FUNCTION	RANGE	CHARACTERISTICS
ASPIRATION		
I/A VACUUM	0 - 500 mmHg	
U/S VACUUM (LO)	0 - 100 mmHg	
U/S VACUUM (HI)	0 - 200 mmHg	
ASPIRATION RATE	10 - 40 cc/MIN	
REFLUX	25 cc/MIN	
U/S POWER		
POWER	0 - 100%	40 kHz, 60 W MAX
VITRECTOR		
RATE	SINGLE CUT (S) 60 - 600 CUTS/MIN	PNEUMATIC, 30 PSI/ATMOSPHERE
CAUTERY		
POWER	0 - 100%	1 MHz SQUARE WAVE, BIPOLAR 0 - 10 W @ 600 Ω LOAD, 50 W MAX

INPUT POWER REQUIREMENTS

NOMINAL VOLTAGE	100/120/220/240 +/- 15%
FREQUENCY	50/60 Hz

GROUND CURRENT LEAKAGE

MAXIMUM CURRENT	<100 uA

ENVIRONMENTAL

OPERATING TEMPERATURE	10°C - 40°C
STORAGE TEMPERATURE	10°C - 50°C
HUMIDITY	15% - 95%, NON-CONDENSING
OPERATING ALTITUDE	3,000 meters
MAXIMUM ALTITUDE	12,000 meters

PHYSICAL

HEIGHT	10.16 cm (4.00 in)	
WIDTH	37.52 cm (14.77 in)	
DEPTH	29.91 cm (11.78 in)	
WEIGHT	12.8 kg (28.3 lb)	CONSOLE + FOOTPEDAL

FRONT PANEL CONTROLS

(REFER TO SPECIFICATIONS (CONSOLE) FIGURE 2, PAGE 9 OF THE OPERATOR'S MANUAL P/N 897182)

MODE

THE DESIRED OPERATING MODE IS SELECTED BY THE MODE SWITCH. THE REFLUX AND CAUTERY FUNCTIONS ARE AVAILABLE ON DEMAND REGARDLESS OF THE POSITION OF THIS SWITCH. WHEN THE DESIRED MODE IS SELECTED, THE ASSOCIATED PANEL CONTROLS ARE IMMEDIATELY ENABLED. LIMITS FOR THE PARAMETERS ARE DETERMINED BY THE SETTINGS OF THESE CONTROLS.

I/A VAC

THE I/A VAC CONTROL SETS THE MAXIMUM PRESET LIMIT FOR VACUUM IN THE I/A AND VIT MODES. THE PRESET IS CONTINUOUSLY VARIABLE OVER THE RANGE 0 - 500 mmHg. THE PRESET I/A VAC VALUE IS DISPLAYED BY THE VACUUM DISPLAY, WHENEVER THE FOOTPEDAL TREADLE IS IN THE RELEASED POSITION AND THE MODE CONTROL IS IN THE I/A OR VIT POSITIONS.

U/S VAC

THE U/S VAC CONTROL SETS THE MAXIMUM PRESET LIMIT FOR VACUUM IN THE U/S LO VAC AND U/S HI VAC MODES. THE RANGES FOR THESE MODES ARE 0 -100 mmHg AND
0 - 200 mmHg RESPECTIVELY. THE PRESET U/S VAC VALUE IS DISPLAYED BY THE VACUUM DISPLAY, WHENEVER THE FOOTPEDAL TREADLE IS IN THE RELEASED POSITION AND THE MODE CONTROL IS IN THE U/S LO VAC OR U/S HI VAC POSITIONS.

VACUUM DISPLAY

WHEN THE FOOTPEDAL TREADLE IS IN THE RELEASED POSITION, THE VACUUM DISPLAY INDICATES THE MAXIMUM PRESET LIMIT FOR VACUUM IN THE SELECTED MODE. WHEN THE FOOTPEDAL TREADLE IS DEPRESSED, THE VACUUM DISPLAY INDICATES THE ACTUAL VACUUM IN THE ASPIRATION TUBING.

RATE

THE RATE CONTROL SETS THE ASPIRATION FLOW RATE OF THE PERISTALTIC PUMP. BECAUSE THE PERISTALTIC PUMP IS A QUASI-CONSTANT DISPLACEMENT DEVICE, FLOW RATE IS LARGELY INDEPENDENT OF ASPIRATION VACUUM. THE CONTROL IS ADJUSTABLE OVER THE RANGE OF 10 - 40 cc/MIN, WITH A SUGGESTED RANGE OF 10 - 20 cc/MIN FOR THE VIT MODE.

REFLUX

THE REFLUX MODE HAS NO ASSOCIATED CONTROL, AS THE PUMP SPEED IS FACTORY PRESET TO -25 cc/MIN, WHENEVER THE REFLUX MODE IS ENABLED. IN THE REFLUX MODE THE FLOW OF THE PERISTALTIC PUMP IS REVERSED. REFLUX IS ENABLED BY DEPRESSING THE REFLUX SWITCH MOUNTED ON THE UNDERSIDE OF THE HOOD OF THE FOOTPEDAL. THE POSITION OF THIS MOUNTING ALLOWS THE USER TO ENGAGE THE REFLUX BY LIFTING HIS FOOT AWAY FROM THE FOOTPEDAL TREADLE UNTIL THE REFLUX SWITCH IS ENGAGED.

U/S POWER

THE U/S POWER CONTROL SETS THE MAXIMUM PRESET LIMIT FOR U/S POWER DELIVERED TO THE U/S HANDPIECE OVER THE RANGE OF 0 - 100%, WHENEVER EITHER OF THE U/S MODES IS SELECTED. THE PRESET VALUE IS DISPLAYED BY THE U/S POWER DISPLAY, WHENEVER THE FOOTPEDAL TREADLE IS IN THE RELEASED POSITION AND THE MODE CONTROL IS IN THE U/S LO VAC OR U/S HI VAC POSITIONS.

U/S POWER DISPLAY

WHEN THE FOOTPEDAL TREADLE IS IN THE RELEASED POSITION, THE U/S POWER DISPLAY INDICATES THE MAXIMUM PRESET LIMIT FOR THE U/S POWER DELIVERED TO THE U/S HANDPIECE. WHEN THE FOOTPEDAL TREADLE IS DEPRESSED, THE U/S POWER DISPLAY INDICATES THE PERCENTAGE OF U/S POWER DELIVERED TO THE U/S HANDPIECE.

PULSE PUSH-BUTTON

THE PULSE PUSH-BUTTON IS AN ALTERNATE ACTION SWITCH THAT SELECTS EITHER THE U/S STANDARD (CONTINUOUS POWER) OR U/S PULSE MODE. WHEN THE PULSE MODE IS SELECTED, THE U/S POWER IS PULSED BETWEEN 0% AND SELECTED POWER AT A 10 Hz RATE.

PULSE INDICATOR

THE PULSE INDICATOR IS ILLUMINATED WHEN EITHER OF THE U/S MODES IS SELECTED AND THE PULSE PUSH-BUTTON HAS BEEN DEPRESSED TO SELECT THE U/S PULSE MODE.

U/S TIME DISPLAY

THE U/S TIME DISPLAY INDICATES THE TOTAL ACCUMULATED TIME THAT U/S POWER HAS BEEN ENABLED SINCE THE LAST SYSTEM POWER-ON, OR SINCE THE RESET PUSH-BUTTON HAS BEEN DEPRESSED. THE TIME IS DISPLAYED IN MINUTES AND TENTHS OF MINUTES.

RESET PUSH-BUTTON

WHEN EITHER U/S MODE IS SELECTED, DEPRESSING THE RESET PUSH-BUTTON WILL RESET THE U/S TIME DISPLAY TO 0.0 MINUTES.

CAUTERY CONTROL

THE CAUTERY CONTROL SETS THE CAUTERY POWER DELIVERED TO THE CAUTERY HANDPIECE OVER THE RANGE OF 0 - 100%. FULL PRESET POWER IS DELIVERED TO THE CAUTERY HANDPIECE, WHENEVER THE CAUTERY SWITCH ON THE FOOTPEDAL IS DEPRESSED.

VIT CONTROL

THE VIT CONTROL SETS THE CUT RATE OF THE VITRECTOR. WITH THE VIT CONTROL IN THE ‘S’ (SINGLE) POSITION, THE VITRECTOR IS CONTINUOUSLY ENERGIZED WHENEVER THE FOOTPEDAL TREADLE IS DEPRESSED. THE CUTTER THEN REMAINS IN THE ENERGIZED POSITION UNTIL THE FOOTPEDAL TREADLE IS RELEASED. WHEN THE VIT CONTROL IS ADVANCED CLOCKWISE FROM THE ‘S’ POSITION, THE CUTTER SPEED IS PRESET OVER THE RANGE OF 60 - 600 CUTS/MIN AND ENABLED VIA THE FOOTPEDAL TREADLE.

REAR PANEL CONTROLS

(REFER TO SPECIFICATIONS (CONSOLE) FIGURE 2, PAGE 9 OF THE OPERATOR'S MANUAL P/N 897182)

ROCKER SWITCH (POWER ON/OFF)

THE ROCKER SWITCH ENABLES THE MAINS INPUT POWER TO THE SYSTEM. THE SYSTEM IS COMPLETELY DISABLED WHEN THE ROCKER SWITCH IS IN THE 0 (OFF) POSITION. IN ADDITION, THE ROCKER SWITCH ALSO FUNCTIONS AS A CIRCUIT BREAKER RESET SWITCH. A MOMENTARY CIRCUIT OVERLOAD THAT TRIGGERS THE PROTECTIVE CIRCUIT BREAKER WILL FORCE THE ROCKER TO THE 0 (OFF) POSITION. THE ROCKER SWITCH MUST BE SET TO 1 (ON) TO RESET THE CIRCUIT BREAKER. REPEATED AUTOMATIC TRIGGERING OF THE PROTECTIVE CIRCUIT BREAKER TO THE 0 (OFF) POSITION IS AN INDICATION OF SYSTEM MALFUNCTION REQUIRING SERVICE.

VOLUME CONTROL, VACUUM FEEDBACK

THE VOLUME CONTROL SETS THE VOLUME OF THE AUDIBLE VACUUM FEEDBACK TONE. WHEN THE FOOTPEDAL TREADLE IS DEPRESSED, THE SYSTEM EMITS AN AUDIBLE TONE WITH A PITCH THAT RISES WITH INCREASING VACUUM.

CONTROL SWITCH

THE CONTROL SWITCH CAN BE SET FOR PANEL OR SURGEON MODE. IN THE PANEL MODE, THE CONTROLLED FUNCTION OPERATES AT THE PRESET LIMIT WHENEVER THE FUNCTION IS ENABLED BY THE FOOTPEDAL. IN THE SURGEON MODE, THE CONTROLLED FUNCTION IS CONTINUOUSLY VARIABLE VIA THE FOOTPEDAL. REFER TO SPECIFICATIONS (FOOTPEDAL & CONTROL SWITCH) FIGURE 3, PAGE 10 OF THE OPERATOR'S MANUAL P/N 897182 FOR FULL FOOTPEDAL CONTROL PARAMETERS.

<u>FRONT PANEL CONNECTORS</u>

(REFER TO SPECIFICATIONS (CONSOLE) FIGURE 2, PAGE 9 OF THE OPERATOR'S MANUAL P/N 897182)

<u>U/S HANDPIECE CONNECTOR</u>

THE U/S HANDPIECE CONNECTOR, LOCATED BELOW THE PULSE PUSH-BUTTON, IS A POLARIZED AND INTERLOCKING CONNECTOR THAT MATES WITH THE CONNECTOR OF THE U/S HANDPIECE. TO BE ENGAGED, THE CONNECTORS MUST BE ROTATED UNTIL THE RED POLARIZING MARKS ARE DIRECTLY OPPOSED. ONCE THE CONNECTORS ARE FULLY ENGAGED, THE SLEEVE OF THE EXTERNAL CONNECTOR MUST BE SLID AWAY FROM THE FRONT PANEL, IN ORDER TO REMOVE THAT CONNECTOR FROM THE PANEL CONNECTOR.

<u>VITRECTOR CONNECTOR</u>

THE VITRECTOR CONNECTOR IS LOCATED BELOW THE VIT CONTROL. IT IS A STANDARD TWIST-LOCK FEMALE LUER CONNECTOR WHICH MATES WITH THE MALE LUER CONNECTOR OF THE VITRECTOR.

<u>CAUTERY HANDPIECE CONNECTOR</u>

THE CAUTERY HANDPIECE CONNECTOR IS A FEMALE BANANA JACK PAIR THAT MATES WITH THE MALE BANANA PLUGS OF THE CAUTERY HANDPIECE. THE CAUTERY POWER OUTPUT IS NON-POLARIZED, AS IS THE CONNECTOR.

REAR PANEL CONNECTORS

(REFER TO SPECIFICATIONS (CONSOLE) FIGURE 2, PAGE 9 OF THE OPERATOR'S MANUAL P/N 897182)

UNIVERSAL IEC POWER INPUT

THE POWER INPUT CONNECTOR IS A FEMALE CONNECTOR THAT MATES WITH POWER CORDS THAT ARE TERMINATED WITH THE STANDARD IEC POWER OUTPUT PLUG. THE POWER CABLE MUST BE OF HOSPITAL GRADE. HOSPITAL GRADE CORDS ARE NORMALLY INDICATED BY THE PRESENCE OF A GREEN COLORED DOT ON THE MALE WALL PLUG OF THE POWER CABLE.

FOOTPEDAL CONNECTOR

THE FOOTPEDAL CONNECTOR IS A FEMALE CIRCULAR CONNECTOR THAT MATES WITH THE MALE CIRCULAR CONNECTOR ATTACHED TO THE FOOTPEDAL. THIS CONNECTOR HAS SEVERAL POLARIZING TABS, WITH THE MAIN (WIDE) TAB AT THE 12 O'CLOCK (VERTICAL) POSITION. THE CONNECTOR IS LOCKED INTO PLACE BY ROTATING THE CAPTIVE THREADED COLLAR OF THE MALE CONNECTOR.

SIDE PANEL COMPONENTS

IRRIGATION PINCH VALVE

THE IRRIGATION PINCH VALVE CONTROLS THE ON/OFF FLOW OF THE BSS IRRIGATING SOLUTION. THE IRRIGATION TUBING CAN BE THREADED THROUGH THE IRRIGATION PINCH VALVE WITHOUT ENABLING THE VALVE BY LIGHTLY STRETCHING THE TUBING WHILE WORKING THE TUBING UP AND DOWN IN THE VALVE TUBING SLOT.

DEPRESSING THE FOOTPEDAL TREADLE OPENS THE PINCH VALVE ALLOWING FOR EASIER LOADING OF THE TUBING. AFTER INSERTION, THE TUBING SHOULD BE VISUALLY CHECKED TO ENSURE THAT IT IS PROPERLY CENTERED IN THE TUBING SLOT OF THE PINCH VALVE.

VACUUM SENSE/VENT PORT

THE VACUUM SENSE/VENT PORT IS CONNECTED TO THE ASPIRATION TUBING VIA THE TUBING SET VACUUM FILTER. THE PORT SENSES THE VACUUM LEVEL PRESENT IN THE ASPIRATION TUBING, AND SIGNALS THE PERISTALTIC PUMP TO STOP AND REMAIN STATIONARY, WHENEVER THE ACTUAL VACUUM LEVEL EQUALS OR EXCEEDS THE PRESET VALUE.

IN ADDITION, THE VACUUM SENSE/VENT PORT IS USED FOR VENTING OF THE ASPIRATION VACUUM UPON FOOTPEDAL TREADLE RELEASE. UPON THE ENABLING OF THE VENT CYCLE, THE INTERNAL VENT SOLENOID ALLOWS ATMOSPHERIC AIR TO PASS THROUGH THE FILTER INTO THE ASPIRATION TUBING, IMMEDIATELY AND COMPLETELY VENTING ALL VACUUM IN THE ASPIRATION TUBING.

PERISTALTIC PUMP

THE PERISTALTIC PUMP IS A NON-CONTACT, QUASI-CONSTANT DISPLACEMENT PUMP THAT CONTROLS ASPIRATION FLOW. WHEN THE HANDPIECE PORT IS OCCLUDED, VACUUM IN THE ASPIRATION TUBING RISES WITH THE CONTINUING ROTATION OF THE PUMP, UNTIL THE OCCLUSION IS BROKEN OR THE VACUUM PRESET LIMIT IS REACHED. IF THE VACUUM PRESET LIMIT IS REACHED, THE PUMP WILL STOP AND REMAIN STOPPED UNTIL THE VACUUM IN THE ASPIRATION TUBING DROPS BELOW THE PRESET LIMIT. INTERMITTENT TURNING OF THE PERISTALTIC PUMP IS AN INDICATION OF LOW FLOW, POSSIBLY CAUSED BY AN OCCLUDED HANDPIECE ASPIRATION PORT OR A SMALL AIR LEAK IN THE ASPIRATION SYSTEM.

OPERATIONAL FUNCTIONS AND MODES

AS DESCRIBED ABOVE, OPERATION MODES ARE SELECTED VIA THE MODE SWITCH. THEY ARE ENABLED VIA THE FOOTPEDAL. WHEN THE FOOTPEDAL TREADLE IS IN THE RELEASED POSITION, THE SYSTEM IS IN STANDBY AND NO MODES ARE ENABLED. IN THE PANEL MODE, WHEN EITHER ASPIRATION VACUUM OR IRRIGATION PRESSURE ARE ENABLED VIA THE FOOTPEDAL, THE SYSTEM AUTOMATICALLY OPERATES AT THE PRESET LIMITS PROGRAMMED, AND THESE LIMITS ARE DISPLAYED AT THE FRONT PANEL. IN THE SURGEON MODE, THE LINEAR CONTROL OF SOME OF THE OPERATING PARAMETERS IS PROVIDED VIA THE FOOTPEDAL. (PLEASE REFER TO SPECIFICATIONS (FOOTPEDAL & CONTROL SWITCH) FIGURE 3, PAGE 10 OF THE OPERATOR'S MANUAL P/N 897182). THE FOLLOWING DESCRIPTIONS PRESENT A BRIEF OVERVIEW OF THE FUNCTIONING OF THE AVAILABLE MODES:

IRRIGATION MODE

THE IRRIGATION MODE IS SELECTED BY SETTING THE MODE SWITCH TO IRR. THE IRR MODE IS ENABLED AS SOON AS THE FOOTPEDAL TREADLE IS DEPRESSED, AND IT STAYS ENABLED THROUGHOUT THE TREADLE TRAVEL. THE IRRIGATING PRESSURE IS A FUNCTION OF THE HEIGHT OF THE IRRIGATION BOTTLE IN REFERENCE TO THE HEIGHT OF THE PATIENTS EYE (THE EYE SHOULD BE AT THE SAME HEIGHT AS THE VACUUM SENSE/VENT PORT. THEREFORE, TO INCREASE OR DECREASE THE IRRIGATION PRESSURE, THE IRRIGATION BOTTLE IS RAISED OR LOWERED, RESPECTIVELY. THE IRRIGATION TUBING MUST BE PRIMED (PURGED OF ALL AIR) BEFORE USE.

IRRIGATION/ASPIRATION MODE

THE IRRIGATION/ASPIRATION MODE IS SELECTED BY SETTING THE MODE SWITCH TO I/A. THE I/A MODE PROVIDES SIMULTANEOUS IRRIGATION AND ASPIRATION. IRRIGATION IS ENABLED AS SOON AS THE FOOTPEDAL TREADLE IS DEPRESSED, AND THE ASPIRATION IS ENABLED, ONCE THE FOOTPEDAL TREADLE IS ADVANCED PAST DETENT 1 (PLEASE REFER TO SPECIFICATIONS (FOOTPEDAL & CONTROL SWITCH) FIGURE 3, PAGE 10 OF THE OPERATOR'S MANUAL P/N 897182). THE PRESET VACUUM LIMIT CAN BE SET OVER THE RANGE OF 0 - 500 mmHg. THE ASPIRATION TUBING MUST BE PRIMED (PURGED OF ALL AIR) BEFORE USE. IN THE PANEL CONTROL MODE, ASPIRATION IS ENABLED AT THE FULL PRESET FLOW RATE. IN THE SURGEON CONTROL MODE, THE FLOW RATE CAN BE LINEARLY CONTROLLED VIA THE FOOTPEDAL TREADLE. AS THE FOOTPEDAL TREADLE IS RELEASED, FULL VENTING OF THE ASPIRATION VACUUM OCCURS AT THE DETENT 1 POINT WHERE ASPIRATION IS DISABLED.

ULTRASONIC STANDARD MODE

THE ULTRASONIC STANDARD MODE IS SELECTED BY SETTING THE MODE SWITCH TO EITHER U/S LO VAC OR U/S HI VAC. IN THESE MODES, THE IRRIGATION AND ASPIRATION FUNCTIONS ARE ENABLED IN AN IDENTICAL MANNER TO THE IRRIGATION/ASPIRATION MODE. ULTRASONIC POWER IS DELIVERED TO THE U/S HANDPIECE, ONCE THE FOOTPEDAL TREADLE IS ADVANCED PAST THE DETENT 2 POSITION (PLEASE REFER TO SPECIFICATIONS (FOOTPEDAL & CONTROL SWITCH) FIGURE 3, PAGE 10 OF THE OPERATOR'S MANUAL P/N 897182). IN THE PANEL CONTROL MODE, FULL PRESET U/S POWER LEVEL IS IMMEDIATELY OBTAINED UPON U/S ENABLE. IN THE SURGEON CONTROL MODE, THE U/S POWER CAN BE LINEARLY CONTROLLED VIA THE FOOTPEDAL TREADLE, UP TO THE PRESET LIMIT. THE PRESET VACUUM LIMIT IS OBTAINED UPON ASPIRATION ENABLE, AND IS NOT VARIABLE VIA SURGEON (FOOTPEDAL) CONTROL.

THE U/S LO VAC AND U/S HI VAC MODES DIFFER ONLY IN THE MAXIMUM LEVEL OF THE PRESET LIMIT VACUUM. IN THE U/S LO VAC MODE, THE ASPIRATION VACUUM LIMIT CAN BE SELECTED OVER THE RANGE OF 0 - 100 mmHg. IN THE U/S HI VAC MODE, THE ASPIRATION VACUUM LIMIT CAN BE SELECTED OVER THE RANGE OF 0 - 200 mmHg. EXTREME CARE MUST BE TAKEN WHENEVER HIGH ASPIRATION VACUUM LIMITS ARE SET IN THE U/S MODE; IT SHOULD NOT BE ASSUMED THAT THE MANUFACTURER CLAIMS ASSURED SAFETY OR EFFECTIVITY FOR THE HIGH U/S ASPIRATION LEVELS ACHIEVABLE WITH THE DGH 9000.

ULTRASONIC PULSE MODE

THE ULTRASONIC PULSE MODE IS SELECTED/DESELECTED BY DEPRESSING THE ALTERNATE ACTION PULSE PUSH-BUTTON, WHEN IN EITHER OF THE U/S MODES (PULSE INDICATOR ILLUMINATED WHEN IN PULSE MODE). OPERATION REMAINS IDENTICAL TO THE ULTRASONIC STANDARD MODES, EXCEPT THE U/S POWER DELIVERED TO THE U/S HANDPIECE IS PULSED AT A 10 Hz RATE.

VITRECTOMY MODE

THE VITRECTOMY MODE IS SELECTED BY SETTING THE MODE SWITCH TO THE VIT POSITION. IN THIS MODE, A PNEUMATIC PRESSURE/ATMOSPHERE SOURCE IS AVAILABLE TO OPERATE A PNEUMATIC GUILLOTINE VITRECTOR. VITRECTOMY IS ENABLED AT THE POINT PAST FOOTPEDAL TREADLE DETENT 1 WHEN ASPIRATION IS ALSO ENABLED. ASPIRATION VACUUM LIMIT IS PRESET BY THE I/A VAC CONTROL, AND ASPIRATION IS FIXED AT THE FULL PRESET VALUE. IN THE PANEL CONTROL MODE, THE ASPIRATION FLOW RATE IS FIXED AT THE PRESET VALUE, AND IN THE SURGEON CONTROL MODE THE FLOW RATE IS LINEARLY VARIABLE PAST DETENT 1 OF THE FOOTPEDAL TREADLE. THE VIT CONTROL SETS THE CUT RATE OF THE VITRECTOR. WITH THE VIT CONTROL IN THE ‘S” (SINGLE) POSITION, THE VITRECTOR IS CONTINUOUSLY ENERGIZED, WHENEVER THE FOOTPEDAL TREADLE IS DEPRESSED. THE CUTTER THEN REMAINS IN THE ENERGIZED POSITION UNTIL THE FOOTPEDAL TREADLE IS RELEASED. WHEN THE VIT CONTROL IS ADVANCED CLOCKWISE FROM THE ‘S’ POSITION, THE CUTTER SPEED IS PRESET OVER THE RANGE OF 60 - 600 CUTS/MIN AND ENABLED VIA THE FOOTPEDAL TREADLE.

CAUTERY MODE

THE CAUTERY CONTROL SETS THE CAUTERY POWER DELIVERED TO THE CAUTERY HANDPIECE OVER THE RANGE OF 0 - 100%. FULL PRESET POWER IS DELIVERED TO THE CAUTERY HANDPIECE, WHENEVER THE CAUTERY SWITCH MOUNTED ON THE LEFT INSIDE OF THE HOOD ON THE FOOTPEDAL IS DEPRESSED. THE CAUTERY POWER IS ISOLATED BIPOLAR DIATHERMY, SQUARE WAVE, AT 1 MHz.

REFLUX MODE

THE REFLUX MODE HAS NO ASSOCIATED CONTROL, AS THE PUMP SPEED IS FACTORY PRESET TO -25 cc/MIN. IN THE REFLUX MODE, THE FLOW OF THE PERISTALTIC PUMP IS REVERSED. THE PANEL/SURGEON CONTROL SWITCH AND MODE SWITCH HAVE NO CONTROL OVER THE REFLUX MODE. REFLUX IS ENABLED BY DEPRESSING THE REFLUX SWITCH MOUNTED ON THE UNDERSIDE OF THE HOOD OF THE FOOTPEDAL. THE POSITION OF THIS MOUNTING ALLOWS THE USER TO ENABLE REFLUX BY LIFTING HIS FOOT AWAY FROM THE FOOTPEDAL TREADLE, UNTIL THE REFLUX SWITCH IS ENGAGED.

RECOMMENDED ACCESSORIES

THE DGH 9000 IS COMPRISED OF THE PHACOEMULSIFICATION CONSOLE AND THE FOOTPEDAL. NORMALLY THE DEVICE IS SOLD WITH A POWER CORD AND U/S HANDPIECE. VARIOUS ACCESSORIES ARE REQUIRED TO COMPLETE THE SYSTEM TO PREPARE FOR SURGERY, AND THESE ARE MADE AVAILABLE THROUGH THE DISTRIBUTOR. DIRECT PURCHASE OF THESE ACCESSORIES FROM THEIR RESPECTIVE MANUFACTURERS IS POSSIBLE, THOUGH FOR CONVENIENCE ARE NORMALLY PURCHASED FROM THE VALUE-ADDED DISTRIBUTOR. RECOMMENDED ACCESSORIES, LIST A SET OF THE MOST COMMONLY USED ACCESSORIES.

RECOMMENDED ACCESSORIES

ITEM	MTP P/N	DESCRIPTION	MFR/VENDOR	MFR/VENDOR P/N
1	899307	TUBING KIT (REUSABLE)	IPAX	KPE220TS
2	899553	FILTER, 5µ	FISHER	DDR50T2550
3	891734	FITTING, LUER COUPLER	COLE-PALMER	06359-42
4	891171-2	U/S TIP, RND 30°	SYN	110.010.30
5	891698	WRENCH	SYN	110.5
6	899497	I/A HANDPIECE	MST	TT-93100
7	891644	ASPIRATION TIP, .3mm	MST	TT-93301
8	891648	ASPIRATION TIP 45°, .3mm	MST	TT-93303
9	899499	VITRECTOR	HSI	U-506P-30
10	899498	IRRIGATION SLEEVE (VIT)	HSI	HS32-516
11	899500	CABLE (CAUTERY)	KIRWIN	10-5000
12	899501	FORCEPS	KIRWIN	10-3000
13	899544	TRAY	RILEY	1025

IPAX INC
(IPAX)
2109 W AMHERST
ENGLEWOOD, CO 80110
TEL: 303-781-2444
FAX: 303-781-2505

FISHER SCIENTIFIC
(FISHER)
711 FORBES AVENUE
PITTSBURGH, PA 15219-4785
TEL: 412-562-8300
FAX: 800-926-1166 (ORDERS)

COLE-PALMER INSTRUMENT CO
(COLE-PALMER)
7425 NORTH OAK PARK AVE
NILES, IL 60714
TEL: 708-647-7600 / 800-323-4340
FAX: 708-647-9660

SYNERGETICS, INC
(SYN)
17466 CHESTERFIELD AIRPORT RD
CHESTERFIELD, MI 63005
TEL: 314-530-1440
FAX: 314-530-1143

MICROSURGICAL TECHNOLOGY
(MST)
8415 154th AVENUE NE
REDMOND, WA 98052
TEL: 206-556-0544
FAX: 206-556-0437

HS INTERNATIONAL CO, INC
(HSI)
5040 COMMERCIAL CIRCLE, UNIT A
CONCORD, CA 94520
TEL: 510-674-1515
FAX: 510-674-1509

KIRWIN SURGICAL
(KIRWIN)
83 E WATER ST
ROCKLAND, MA 02370
TEL: 617-878-2706
FAX: 617-871-2816

RILEY MEDICAL, INC
(RILEY)
27 WRIGHTS LANDING
AUBURN, ME 04210
TEL: 207-786-2775
FAX: 207-786-5553

SYSTEM FUNCTIONAL CHECKOUT

REQUIRED TEST EQUIPMENT AND TOOLS

THE TEST EQUIPMENT, TOOLS, AND SUPPLIES REQUIRED TO PERFORM THE TASKS PRESENTED IN THIS SECTION ARE LISTED BELOW. THE PROCEDURES WERE WRITTEN FOR USE WITH THE EQUIPMENT LISTED. ITEMS OTHER THAN THOSE LISTED MAY BE USED IF THEY MEET OR EXCEEDS THE PERFORMANCE OF THE LISTED EQUIPMENT.

AN OPERATOR'S MANUAL P/N 897182 IS REQUIRED FOR SYSTEM SETUP AND SYSTEM TEST.

TEST AND REPAIR KIT

- OSCILLOSCOPE, OR ANALOG (NEEDLE) MULTIMETER WITH HIGH REQ DERATING CURVE
- DIGITAL VACUUM/PRESSURE GAUGE
- 600Ω POWER RESISTOR
- STOPWATCH
- CHECK VALVE
- TUBING KIT (QTY 2)
- SYRINGE
- SQUARE NUT PHACO TIP
- TEST CHAMBER
- GRADUATED CYLINDER
- HEMOSTAT
- ALLEN WRENCHES
- NUT DRIVERS
- OPEN END WRENCHES
- PHILLIPS SCREWDRIVERS
- ADJUSTMENT TOOL

IRRIGATION VALVE TEST

CONNECT THE IRRIGATION BOTTLE AND TUBING TO THE DGH 9000 PER U/S HANDPIECE SYSTEM SETUP (IRRIGATION TUBING SET) FIGURE 10 OF THE OPERATOR'S MANUAL P/N 897182, LEAVING THE END OF THE IRRIGATION TUBING UNCONNECTED TO THE U/S HANDPIECE. PRIME THE IRRIGATION TUBING TO PURGE ANY AIR FROM THE TUBING. OBSERVE THE END OF THE TUBING. WITH THE FOOTPEDAL TREADLE IN THE RELEASED POSITION, THERE MUST BE NO IRRIGATING SOLUTION FLOW FROM THE TUBING END.

SUSPEND THE TUBING END ABOVE THE GRADUATED CYLINDER; WITH THE IRRIGATION TUBING END 65 cm BELOW THE SURFACE LEVEL OF THE SOLUTION IN THE DRIP CHAMBER. WITH THE MODE SWITCH IN THE IRR POSITION, DEPRESS THE FOOTPEDAL TREADLE FOR 60 SECONDS AND MONITOR THE FLOW OF FLUID INTO THE GRADUATED CYLINDER. THE IRRIGATION FLOW RATE MUST BE A MINIMUM OF 40 cc/MIN.

VACUUM TESTS

CONNECT THE ASPIRATION TUBING ONLY, PER U/S HANDPIECE SYSTEM SETUP (ASPIRATION TUBING SET) FIGURE 11 OF THE OPERATOR'S MANUAL P/N 897182, LEAVING THE END OF THE ASPIRATION TUBING UNCONNECTED TO THE U/S HANDPIECE. INSTEAD, CONNECT THAT END TO THE VACUUM/PRESSURE METER. WITH THE MODE SWITCH IN THE I/A, U/S VAC LO, AND U/S VAC HI POSITIONS, CHECK THE VACUUM RANGE AT THE MINIMUM SETTING, AND IN 20% OF MAX INCREMENTS. PLACE THE CONTROL SWITCH IN THE PANEL POSITION, AND DEPRESS AND HOLD THE FOOTPEDAL TREADLE TO ENABLE VACUUM. OBSERVE THE ASPIRATION VACUUM DISPLAY. THE VACUUM SHOULD BUILD AND REACH A MAXIMUM VALUE NEAR THE PRESET LIMIT. ACCURACY SHOULD BE 1% OF FULL SCALE PLUS 10% OF SETTING, BOTH ON THE ASPIRATION VACUUM DISPLAY AND THE EXTERNAL VACUUM/PRESSURE METER.

AT THIS POINT THE PERISTALTIC PUMP HEAD SHOULD STOP ROTATING. THE PUMP HEAD SHOULD REMAIN MOTIONLESS UNTIL SYSTEM COMPLIANCE OR SMALL AIR LEAKS REQUIRE ADDITIONAL ROTATION TO MAINTAIN THE PRESET VACUUM LEVEL. IN THE I/A MODE, WITH THE PRESET VACUUM SET TO 400 cc/MIN, THE PUMP ROLLER SHOULD REMAIN MOTIONLESS FOR A PERIOD OF 5 OR MORE SECONDS ONCE PRESET VACUUM IS REACHED. SHORTER PERIODS OF NON-ROTATION ARE INDICATIVE OF ONE OR MORE SMALL AIR LEAKS, EITHER INTERNAL OR EXTERNAL TO THE DGH 9000. EXTERNAL LEAKS PRESENT IN THE ASPIRATION TUBING CIRCUIT MAY STEM FROM SMALL CUTS IN THE SOFT SILICONE TUBING, OR AT ANY POINT OF CONNECTION, INCLUDING CONNECTIONS TO THE FILTER.

FLUIDICS TESTS

PERFORM THE FOLLOWING LIST OF TESTS PER THE OPERATOR'S MANUAL P/N 897182.

TEST	PAGE	FIGURE
U/S HANDPIECE SYSTEM TEST (IRRIGATION FLOW)	21	14
U/S HANDPIECE SYSTEM TEST (ASPIRATION VENT)	22	15
U/S HANDPIECE SYSTEM TEST (IOP MAINTENANCE)	23	16
I/A HANDPIECE SYSTEM TEST (IRRIGATION FLOW)	31	24
I/A HANDPIECE SYSTEM TEST (ASPIRATION VENT)	32	25
I/A HANDPIECE SYSTEM TEST (IOP MAINTENANCE)	33	26

U/S TESTS

SET THE MODE SWITCH TO U/S LO VAC, THE PULSE PUSH-BUTTON TO U/S STD (NON-PULSE), THE U/S POWER CONTROL TO 100% AND THE CONTROL SWITCH TO SURGEON. ATTACH A STANDARD PHACO TIP (WITH SQUARE HUB CONFIGURATION) TO THE U/S HANDPIECE. SUSPEND THE HANDPIECE ABOVE A CONTAINER OF WATER WITH THE TIP FULLY IMMERSED IN THE WATER. SLOWLY DEPRESS THE FOOTPEDAL TREADLE COMPLETELY. WHEN THE FOOTPEDAL TREADLE POSITION PASSES DETENT 2, A FAINT HISSING SOUND SHOULD COME FROM THE U/S HANDPIECE TIP. AS THE FOOTPEDAL TREADLE IS FURTHER DEPRESSED, THE HISSING SOUND SHOULD CONTINUOUSLY INCREASE IN VOLUME TO THE MAXIMUM TREADLE POSITION. ONCE THE MAXIMUM TREADLE POSITION IS REACHED, MAINTAIN THAT POWER LEVEL AND SLOWLY RAISE THE HANDPIECE AWAY FROM THE WATER, WITHOUT COMPLETELY REMOVING THE TIP FROM THE WATER. WHEN THE ATTACHMENT NUT OF THE TIP REACHES THE WATER SURFACE, A CRATER DEPRESSION IN THE WATER SURFACE SHOULD BE CREATED DUE TO CAVITATION. IF THE POSITION OF THE HANDPIECE IS MAINTAINED AT THIS LEVEL, THE CAVITATION CRATER SHOULD BE MAINTAINED. NOTE THAT ANY WATER FLOW FROM THE HANDPIECE SHOULD BE DIVERTED FROM THE WATER CONTAINER, AND SHOULD NOT DRIP INTO THE AREA OF CAVITATION. ONCE THE PRESENCE OF THE CAVITATION CRATER HAS BEEN CONFIRMED, LOWER THE HANDPIECE TO THE ORIGINAL POSITION WITH THE TIP FULLY IMMERSED. GRADUALLY RELEASE THE FOOTPEDAL TREADLE TO THE DETENT 2 POSITION. THE HISSING SOUND FROM THE TIP SHOULD STEADILY AND CONTINUOUSLY DECREASE IN VOLUME.

VIT TESTS

CONNECT THE VACUUM/PRESSURE METER IN SERIES WITH THE TEST CHECK VALVE, WITH THE OUTLET OF THE CHECK VALVE TOWARDS THE METER. CONNECT THE INLET OF THE CHECK VALVE TO THE FRONT PANEL VIT CONNECTOR. SET THE MODE TO VIT, AND ENABLE VIT VIA THE FOOTPEDAL. VIT SHOULD BE ENABLED ONCE THE FOOTPEDAL TREADLE IS DEPRESSED PAST THE DETENT 1 POSITION. INITIALLY SETTING THE VIT CONTROL TO S, THEN AT 100 CUTS/MIN, AND FINALLY AT 600 CUTS/MIN CHECK THE PRESSURE INDICATED ON THE VACUUM/PRESSURE METER. THE PRESSURE MUST BE 30-PSI MINIMUM. VENT THE METER BETWEEN READINGS. REVERSE THE CHECK VALVE (WITH THE INLET OF THE CHECK VALVE TOWARDS THE PRESSURE METER) AND REPEAT THE TESTS. THE PRESSURE METER MUST INDICATE LESS THAN 5 PSI.

DISCONNECT THE CHECK VALVE AND METER. ENABLE VIT WHILE COUNTING THE AUDIBLE PNEUMATIC PULSATION. CHECK THE CUT RATE AT THE MAJOR CALIBRATION POINTS OF THE VIT KNOB BY CHECKING THE COUNT AGAINST THE CALIBRATED TIMEPIECE.

CONNECT THE VITRECTOR LISTED IN THE ACCESSORIES SECTION OF THIS MANUAL TO THE VIT CONNECTOR. WHILE KEEPING THE TIP OF THE VITRECTOR IMMERSED IN WATER AT ALL TIMES, OBSERVE THE VITRECTOR ASPIRATION PORT. THE PORT SHOULD BE SEEN TO OPEN AND CLOSE WITH EACH PNEUMATIC CYCLE, EVEN AT THE HIGHEST CUT RATE (600 CUTS/MIN).

CAUTERY TEST

CONNECT THE 600 OHM CAUTERY TEST LOAD RESISTOR TO THE CAUTERY BANANA JACKS. CONNECT THE OSCILLOSCOPE TO THE RESISTOR IN DIFFERENTIAL MODE. ENABLE CAUTERY BY DEPRESSING THE CAUTERY FOOTSWITCH. AT THE 100% POWER LEVEL THE OUTPUT WAVEFORM MUST BE 160 V P-P +/- 15%, AT A FREQUENCY OF 1.0 MHz +/- 15%.
AT THAT POWER LEVEL THE RESISTOR WILL DISSIPATE APPROXIMATELY 10 WATTS, AND WILL BEGIN TO NOTICEABLY INCREASE IN TEMPERATURE. THIS HEATING IS NORMAL, AND IS AN INDICATION THAT DIATHERMY ENERGY IS BEING TRANSMITTED TO THE RESISTOR LOAD. WHILE MAINTAINING CAUTERY ENABLE, DECREASE THE CAUTERY CONTROL SETTING TO 0%. THE VOLTAGE ACROSS THE CAUTERY LOAD RESISTOR MUST DECREASE CONTINUOUSLY TO LESS THAN 8 V P-P AT THE 0% SETTING.

THEORY OF OPERATION

INTRODUCTION

THE DGH 9000 IS DESIGNED IN MODULAR FORM, AND REPAIR AND REPLACEMENT ARE TO BE ACCOMPLISHED ONLY AT THE MODULAR LEVEL. THEREFORE, THE THEORY OF OPERATION OF THE DGH 9000 EXTENDS ONLY TO THE MODULAR LEVEL.

FRONT PANEL ASSEMBLY

THE FRONT PANEL CONNECTIONS AND DESIGNATORS ARE LISTED ON PAGE 33 (THE INTERNAL SIGNALS SECTION OF THE TROUBLESHOOTING GUIDE), ALONG WITH THE NOMINAL RANGES OF VOLTAGES AND SIGNALS. THE FIVE (5)-CONTROL POTENTIOMETERS ARE CONNECTED POTENTIOMETRICALLY, AND THE VOLTAGE AT THE WIPER OF EACH POT SHOULD VARY CONTINUOUSLY WITH THE POTENTIOMETER SETTING.

THE MODE SWITCH GROUNDS, IN TURN, EACH OF THE FIVE (5) MODE SWITCH OUTPUTS. THEREFORE, THE OUTPUT PIN OF THE MODE SELECTED SHOULD MEASURE APPROXIMATELY 0 V. ALL OTHER OUTPUTS OF THE SWITCH SHOULD MEASURE 5 V.

THE FRONT PANEL METERS INDICATE VACUUM LEVEL, U/S POWER SETTING, AND ACCUMULATED U/S ENABLED TIME. POT R25 ADJUSTS THE CALIBRATION OF THE TIMER DISPLAY. BECAUSE THE TIMER IS CONFIGURED USING A VOLTMETER DISPLAY, THE TIMER CAN BE ADJUSTED IN THE STATIC POSITION BY ACCUMULATING A KNOWN U/S ENABLED TIME, AND THEN ADJUSTING THE DISPLAY FOR THAT TIME WHILE U/S POWER IS DISABLED. POT R26 ADJUSTS THE CALIBRATION OF THE VACUUM DISPLAY. POT R29 ADJUSTS CALIBRATION OF THE U/S POWER DISPLAY. THE U/S POWER DISPLAY IS CALIBRATED WHEN THE POWER CONTROL IS SET AT THE MAXIMUM CLOCKWISE POSITION AND THE DISPLAY READS 100%. THE VACUUM DISPLAY SHOULD BE CALIBRATED TO READ 500 mmHg WHEN AN EXTERNAL VACUUM/PRESSURE METER INDICATES THAT 500 mmHg OF VACUUM IS BEING APPLIED TO THE VACUUM/VENT PORT. FOR CALIBRATION PURPOSES, A 20 cc SYRINGE CAN BE CONNECTED TO THE VACUUM/VENT PORT TO CREATE THE APPROPRIATE VACUUM, AND A TEE FITTING CAN BE CONNECTED IN SERIES TO ALLOW THE VACUUM/PRESSURE METER TO MONITOR THE VACUUM LEVEL.

TRANSDUCER SENSE/VENT ASSEMBLY

THE TRANSDUCER SENSE/VENT SIGNALS (CONN J4) ARE LISTED ON PAGE 35 (THE INTERNAL SIGNALS SECTION OF THE TROUBLESHOOTING GUIDE), ALONG WITH THE NOMINAL RANGES OF VOLTAGES. THE MODULE HAS TWO FUNCTIONS. ONE FUNCTION IS TO AMPLIFY THE SIGNALS FROM THE VACUUM TRANSDUCER, AND CONVERT THOSE SIGNALS TO A HIGH LEVEL OUTPUT SIGNAL. THE SPAN OF THIS SIGNAL (VACACT) IS 0.00 V AT ATMOSPHERE, TO 2.500 V FOR 500 mmHg VACUUM. THE GAIN OF THE AMPLIFIER IS SET BY PRECISION RESISTORS, AND THEREFORE DOES NOT NEED ADJUSTMENT. ZERO DRIFT OVER TIME IS POSSIBLE, AND R27 ADJUSTS THE AMPLIFIER ZERO READING.

THE OTHER FUNCTION OF THE TRANSDUCER SENSE/VENT ASSEMBLY IS TO VENT THE VACUUM AT THE VACUUM SENSE/VENT PORT, UPON RELEASE OF THE FOOTPEDAL TREADLE. WHEN THE SW2 SIGNAL CHANGES FROM 1 TO 0, THE TIMERS OF THE ASSEMBLY ARE TRIGGERED. THE TIMERS ARE CONFIGURED SO THAT THE VENT SOLENOID IS ENERGIZED PAST THE POINT IN TIME WHEN THE VACACT OUTPUT IS SEEN TO RETURN TO 0.0 VOLTS. IN THIS WAY, VENTING TO THE ZERO VACUUM LEVEL IS ASSURED. HOWEVER, DUE TO COMPLIANCE OF THE ASPIRATION TUBING, THE VACUUM LEVEL AFTER VENTING MAY CREEP UP FROM THE INITIAL ZERO READING TO A SMALL VACUUM LEVEL. THIS EFFECT IS NORMAL AND EXPECTED, BEING OF NO CONSEQUENCE. IT SHOULD BE NOTED THAT A ZERO VACUUM READING IS DEPENDENT UPON THE HANDPIECE BEING HELD AT THE SAME HEIGHT AS THE VACUUM SENSE/VENT PORT. DUE TO THE EFFECT OF GRAVITY ON THE FLUID IN THE ASPIRATION TUBING, THE VENTED VACUUM READING WILL BE SHIFTED WITH CHANGES IN VERTICAL POSITIONING OF THE HANDPIECE.

U/S CONTROLLER ASSEMBLY

THE U/S CONTROLLER BOARD CONTAINS THE MAJORITY OF THE ANALOG AND DIGITAL LOGIC AND CONTROL ELEMENTS NECESSARY TO CONTROL THE COMPLETE SYSTEM. IN ADDITION, THE U/S CONTROLLER INCORPORATES THE U/S, CAUTERY, IRRIGATION SOLENOID AND MOTOR DRIVERS.

THE ANALOG AND DIGITAL CONTROL SYSTEMS HAVE AS INPUTS THE FRONT AND BACK PANEL CONTROLS, THE VACUUM TRANSDUCER AND THE FOOTPEDAL. THE DIGITAL FUNCTIONS ARE 5V LOGIC, THE ENABLED CONDITION BEING DENOTED BY THE PRESENCE OR ABSENCE OF THE 'NOT' (*) OPERATOR ON THE SIGNAL DESIGNATOR. AS AN EXAMPLE, A CONTROL LINE DESIGNATED 'VIT*' HAS THE PRESENCE OF THE '*' (NOT) OPERATOR, AND THUS, THE 'VIT*' CONTROL INPUT IS NEGATIVE TRUE. THEREFORE, VIT IS ENABLED WHEN THAT INPUT IS LO (0 V). BY CONTRAST, THE DESIGNATOR 'SW2' DOES NOT CONTAIN THE '*' (NOT) OPERATOR, AND THUS THE 'SW2' CONTROL INPUT IS POSITIVE TRUE, AND IS ENABLED WHEN THAT INPUT IS HI (+5V).

THE U/S DRIVER IS AN AUTOTUNED 40 kHz GENERATOR THAT DERIVES THE TUNING FEEDBACK SIGNAL FROM THE ELECTRICAL CHARACTERISTICS OF THE U/S HANDPIECE. THUS, FOR THE U/S POWER OUTPUT TO BE STABLE, THE U/S HANDPIECE MUST BE ELECTRICALLY REPRESENTATIVE OF A NORMAL FUNCTIONING HANDPIECE. SITUATIONS SUCH AS A LOOSE U/S TIP, INCORRECT U/S TIP, SHORTED HANDPIECE OR AN INCORRECT MODEL HANDPIECE WILL RESULT IN A LACK OF FREQUENCY STABILITY, WHICH NEGATIVELY AFFECTS TIP DISPLACEMENT. THE U/S DRIVER INCORPORATES A GROUND FAULT DETECTION CIRCUIT THAT DISABLES ALL U/S POWER TO THE U/S HANDPIECE IF THE CASE OF THE HANDPIECE LOSES CONNECTION TO THE CHASSIS SAFETY GROUND. THIS CONDITION CAN BE MONITORED AT THE GFAULT OUTPUT OF THE U/S CONTROLLER AT J3-10. A HIGH LEVEL AT THIS PIN INDICATES THAT A GROUND FAULT CONDITION HAS BEEN IDENTIFIED, AND THAT THE U/S DRIVER IS DISABLED.

THE CAUTERY DRIVER IS A 1 MHz, CONSTANT VOLTAGE, And ISOLATED BIPOLAR SQUARE WAVE GENERATOR. THE ONLY CONTROLS TO THIS GENERATOR ARE THE CAUTERY ENABLE FOOTPEDAL SWITCH AND THE CAUTERY POWER LEVEL FRONT PANEL CONTROL.

THE IRRIGATION SOLENOID DRIVER IS CONTROLLED BY THE FOOTPEDAL ONLY. THE IRRIGATION SOLENOID IS ENERGIZED WHENEVER THE FOOTPEDAL TREADLE IS DEPRESSED. INITIALLY THE IRRIGATION SOLENOID IS DRIVEN BY +24 VDC TO INSURE PULL-IN. ONCE THE SOLENOID IS ENGAGED, THE IRRIGATION SOLENOID CURRENT IS REGULATED BY A PULSE WIDTH MODULATION DRIVER.

THE MOTOR DRIVER INCORPORATES A BI-DIRECTIONAL DC MOTOR CONTROLLER. THE NEGATIVE INPUT TO THE MOTOR IS GROUNDED, AND BOTH DIRECTIONAL AND SPEED CONTROL ARE ACHIEVED BY THE POLARITY AND LEVEL OF THE VOLTAGE APPLIED TO THE PERMANENT MAGNET MOTOR. TO ACHIEVE SPEED REGULATION, THE MOTOR INCORPORATES A FEEDBACK WINDING WHOSE OUTPUT IS FED BACK TO A SUMMING NODE AT THE INPUT TO THE CONTROLLER. THUS, MOTOR INPUT CURRENT INCREASES WITH FRICTIONAL LOAD, MAINTAINING A CONSTANT MOTOR SPEED.

VIT ASSEMBLY

THE VIT ASSEMBLY IS COMPRISED OF A +24 VDC POWERED AIR COMPRESSOR, A BI-DIRECTIONAL PNEUMATIC VALVE, AS WELL AS CONTROL ELECTRONICS. THESE ELECTRONICS CONSIST OF A COMPRESSOR ENABLE RELAY AND AN ADJUSTABLE RATE OSCILLATOR COUPLED TO A SOLENOID DRIVER. WHEN DRIVEN, THE SOLENOID ALTERNATELY CONNECTS THE VIT FRONT PANEL LUER CONNECTOR TO THE COMPRESSED AIR, AND THEN TO ATMOSPHERE. THE RATE OF THE OSCILLATOR IS CONTROLLED BY THE FRONT PANEL VIT CONTROL. WHEN THE MODE SWITCH IS IN THE VIT POSITION, THE COMPRESSOR RELAY AND SOLENOID DRIVER ARE ENABLED WHENEVER THE FOOTPEDAL TREADLE PASSES THE DETENT 1 POSITION.

AUDIO VAC ASSEMBLY

THE AUDIO VAC ASSEMBLY PERFORMS SEVERAL FUNCTIONS. IT ACTS AS INTERCONNECT FOR THE FOOTPEDAL, INTERCONNECT FOR THE REAR PANEL CONTROL SWITCH AND PROVIDES AUDIO FEEDBACK OF THE ASPIRATION VACUUM LEVEL. WITH THE PITCH OF THE FEEDBACK TONE RISES WITH INCREASING ASPIRATION VACUUM. THE AUDIO OUTPUT LEVEL INCREASES WITH CLOCKWISE ROTATION OF THE VOLUME CONTROL. SETTING THIS CONTROL TO THE MOST COUNTER-CLOCKWISE POSITION INHIBITS THE VACUUM FEEDBACK TONE. IN ADDITION, THE AUDIO VAC ASSEMBLY EMITS A HIGH PITCHED TONE WHENEVER CAUTERY IS ENABLED.

POWER SUPPLY ASSEMBLY

THE POWER SUPPLY ASSEMBLY INCORPORATES AN AUTOMATIC MAINS-VOLTAGE SELECTION CIRCUIT THAT ALLOWS THE DGH 9000 TO BE IMMEDIATELY CONNECTED TO ANY 50/60 Hz 100/115/220/230/240 VAC POWER SOURCE. THE POWER ON/OFF ROCKER SWITCH INCORPORATES AN INPUT PROTECTION CIRCUIT BREAKER. NO FUSES ARE USED IN THIS, OR ANY OTHER ASSEMBLY IN THE DGH 9000. THE DC OUTPUTS OF THE POWER SUPPLY ARE +25V, +12V, +5V, -5V AND -12V. THE OUTPUTS ARE SHORT CIRCUIT LIMITED, AND ARE WELL REGULATED.

MAINTENANCE

INTRODUCTION

THE DGH 9000 IS DESIGNED TO BE VIRTUALLY MAINTENANCE FREE, REQUIRING ONLY ROUTINE CLEANING. BECAUSE BSS IRRIGATING SOLUTION IS CORROSIVE AND ELECTRICALLY CONDUCTIVE, IT IS IMPORTANT TO REMOVE BSS RESIDUE IMMEDIATELY AFTER USE. THE IRRIGATION SOLENOID AND PERISTALTIC PUMP MUST BE KEPT FREE OF BSS AND SILICONE TUBING RESIDUE, AS WELL AS OTHER DEBRIS, TO INSURE THAT NO DEBRIS WILL INTERFERE WITH THE MECHANICAL ACTION OF THESE DEVICES.

REQUIRED TOOLS AND SUPPLIES

AS NO ADJUSTMENTS OR LUBRICATIONS ARE REQUIRED TO MAINTAIN PERFORMANCE, ONLY NORMAL CLEANING SUPPLIES ARE NECESSARY TO PERFORM MAINTENANCE. TYPICALLY THESE WOULD INCLUDE ISOPROPYL ALCOHOL (IPA), LOW LINT WIPERS AND COTTON SWABS. THE USE OF TWEEZERS OR FORCEPS WILL ALLOW EASY REMOVAL OFF FOREIGN MATERIAL FROM THE MECHANISMS.

ROUTINE MAINTENANCE

IMMEDIATELY AFTER USE, THE UNIT SHOULD BE WIPED FREE OF ANY SPILLED BSS, THE MECHANISMS INSPECTED AND CLEANED OF ANY FOREIGN MATERIAL AND DEBRIS, AND THE UNIT WIPED CLEAN BY THE USE OF IPA MOISTENED WIPERS.

SERVICE

INTRODUCTION

THE DGH 9000 IS DESIGNED IN MODULAR FORM, AND REPAIR AND REPLACEMENT ARE INTENDED TO BE ACCOMPLISHED ONLY AT THE MODULAR LEVEL. REPLACEMENT MODULES ARE AVAILABLE FROM THE MANUFACTURER ON AN OVERNIGHT SHIPMENT BASIS. BECAUSE THE DGH 9000 CONTAINS NO USER SERVICEABLE PARTS AND THE CIRCUITRY IS EASILY SUBJECT TO MISHANDLING, SERVICE SHOULD ONLY BE ATTEMPTED BY QUALIFIED SERVICE PERSONNEL. SERIOUS ELECTRICAL SHOCK HAZARD IS PRESENT WHEN THE COVER IS REMOVED WHILE THE DEVICE IS CONNECTED TO THE POWER SOURCE, EVEN WHEN THE POWER ON/OFF ROCKER SWITCH IS IN THE 0 (OFF) POSITION.

REQUIRED TEST EQUIPMENT, TOOLS AND SUPPLIES

ONLY COMMONLY AVAILABLE TEST EQUIPMENT, TOOLS AND SUPPLIES ARE NEEDED TO SERVICE THE DGH 9000. RECOMMENDATIONS FOR TEST EQUIPMENT, TOOLS AND SUPPLIES ARE LISTED ON PAGE 14 FOR THE TEST AND REPAIR KIT. ITEMS OTHER THAN THOSE LISTED MAY BE USED IF THEY MEET OR EXCEED THE PERFORMANCE OF THE ITEMS LISTED.

DISASSEMBLY

CASE/CHASSIS

DISCONNECT ALL EXTERNAL CONNECTIONS INCLUDING FOOTPEDAL AND POWER CORD. REMOVE THE CAP SCREW AT THE LOWER REAR CORNER OF EACH SIDE PLATE USING A 7/64 IN ALLEN WRENCH. REMOVE THE FOUR (4) BUTTON-HEAD SCREWS ON THE UNDER SIDE OF THE CHASSIS BELOW THE FRONT PANEL USING A 5/64 IN ALLEN WRENCH.
REMOVE THE TOP COVER BY PULLING UPWARDS ON THE REAR OVERHANGING LIP OF THE COVER. UNPLUG THE TWO (2) CABLES LOCATED AT THE TOP OF THE FRONT PANEL CIRCUIT BOARD AT THE J1 AND J2 CONNECTORS. ON THE U/S CONTROLLER BOARD, UNPLUG THE PINCH VALVE AT THE J6 CONNECTOR. UNPLUG THE U/S CONNECTOR AT THE J5 CONNECTOR. DISCONNECT THE TUBING FROM THE VIT CONNECTOR AT THE IN-LINE CONNECTOR. UNPLUG THE CABLE FROM THE TRANSDUCER SENSE/VENT ASSEMBLY AT THE J40 CONNECTOR. SEPARATE THE SIDE PANELS AND FRONT PANEL AS A SINGLE UNIT FROM THE CHASSIS BY LIFTING STRAIGHT UP. SOME FORCE MAY BE NECESSARY, AS THE COMPONENTS ARE TIGHT FITTING. RAISE THE PANEL ASSEMBLY TWO (2) INCHES AND DISCONNECT THE CAUTERY CABLE AT THE U/S CONTROLLER BOARD AT J20. DISCONNECT THE PERISTALTIC PUMP MOTOR CABLE AT THE U/S CONTROLLER AT J9. REMOVE THE FRONT/SIDE PANEL ASSEMBLY AS A UNIT FROM THE CHASSIS ASSEMBLY.

FRONT PANEL ASSEMBLY

ON THE PANEL ASSEMBLY, REMOVE THE PAIR OF PHILLIPS-HEAD SCREWS THAT HOLD EACH SIDE PANEL TO THE FRONT PANEL. DETACH THE FRONT PANEL FROM THE FRONT BEZEL BY REMOVING THE ATTACHING FOUR (4) PHILLIPS HEAD SCREWS.

FRONT PANEL PCB

SEPARATE THE FRONT PANEL PCB FROM THE FACEPLATE BY FIRST REMOVING THE KNOBS USING A 1/16 IN ALLEN WRENCH. REMOVE THE HARDWARE SECURING THE POTENTIOMETERS USING A 5/16 IN NUT DRIVER. REMOVE THE HARDWARE SECURING THE ROTARY SWITCH (MODE) USING A 3/8 IN NUT DRIVER. ON THE BACK OF THE ASSEMBLY, REMOVE THE HEX HEAD NUTS NEAR THE U/S POWER CABLE USING A 5/16 IN NUT DRIVER. SEPARATE THE PCB ASSEMBLY FROM THE FRONT PANEL. COMPONENT MIS-ALIGNMENT AS WELL AS ADHESION AT THE DISPLAY/OVERLAY INTERFACE WILL IMPEDE REMOVAL. BOTH THE SWITCH EXTENDERS, AND THE BLACK, DISPLAY MASK FILM PIECES MAY ADHERE TO THE OVERLAY. IF SO, THEY CAN BE LEFT IN PLACE.

SIDE PANEL DISASSEMBLY

MOUNTED TO THE RIGHT SIDE PANEL ARE THE IRRIGATION PINCH VALVE, THE TRANSDUCER SENSE/VENT ASSEMBLY AND THE PERISTALTIC PUMP ASSEMBLY. REMOVE THE PINCH VALVE BY REMOVING THE THREE (3) CAP HEAD SCREWS SECURING IT TO THE PANEL USING A 3/32 IN ALLEN WRENCH. REMOVE THE TRANSDUCER SENSE/VENT BY REMOVING THE TWO PHILLIPS HEADS SCREWS RECESSED IN THE PLASTIC VACUUM CHAMBER ASSEMBLY. ONE SCREW IS VISIBLE AT THE TOP LEFT CORNER OF THE ASSEMBLY. THE OTHER SCREW IS RECESSED IN THE ROUND HOLE BELOW THE VENT SOLENOID. REMOVE THE PERISTALTIC PUMP ASSEMBLY BY FIRST REMOVING THE PUMP ROLLER HEAD USING A 5/64 IN ALLEN WRENCH. REMOVE THE MOTOR BY REMOVING THE THREE (3) SMALLER CAP SCREWS ON THE PUMP PLATE USING A 3/32 IN ALLEN WRENCH. REMOVE THE PUMP PLATE FROM THE SIDE PLATE BY REMOVING THE THREE (3) LARGER CAP SCREWS USING A 7/63 IN ALLEN WRENCH.

U/S CONTROLLER

BEFORE REMOVING THE U/S CONTROLLER BOARD, INSURE THAT ALL INTERCONNECT CABLES HAVE BEEN UNPLUGGED. THEN REMOVE THE SEVEN (7) PHILLIPS HEAD SCREWS SECURING THE ASSEMBLY; THREE (3) ON THE FRONT EDGE OF THE BOARD, THREE (3) ON THE REAR EDGE, AND ONE (1) IN THE CENTER OF THE BOARD.

<u>VIT</u>

REMOVE THE COMPLETE VIT ASSEMBLY BY REMOVING THE FOUR (4) PHILLIPS HEAD SCREWS SECURING IT ON THE UNDERSIDE OF THE CHASSIS.

<u>POWER SUPPLY</u>

REMOVE THE POWER SUPPLY BY FIRST REMOVING THE FOUR (4) NUTS AT THE CORNERS OF THE PCB USING A 1/4 IN HEX WRENCH. REMOVE THE TOP NUT HOLDING THE POWER RECEPTACLE TO THE CHASSIS USING A 5/16 IN OPEN END WRENCH. REMOVE THE BOTTOM NUT OF THE RECEPTACLE USING A 5/16 IN NUT DRIVER PLACED THROUGH THE ACCESS HOLE IN THE PCB. SLIDE THE ASSEMBLY AWAY FROM THE CHASSIS STANDOFFS, AND THEN DISCONNECT THE GROUNDING JUMPER ATTACHED TO THE CHASSIS USING A 5/16 IN WRENCH.

<u>AUDIO VAC</u>

ON THE REAR EXTERIOR OF THE CHASSIS, REMOVE THE VOLUME KNOB USING A 1/16 IN ALLEN WRENCH. REMOVE THE EXPOSED SHAFT MOUNTING NUT USING A 5/16 IN NUT DRIVER. REMOVE THE SIX (6) NUTS SECURING THE PCB TO THE CHASSIS USING A 1/4 IN NUT DRIVER. NOTE THE LOCATION OF THE GROUNDING WIRE WITH LUG FOR RE-ASSEMBLY. DISCONNECT THE GROUNDING JUMPER ATTACHED TO THE CHASSIS USING A 5/16 IN WRENCH.

TROUBLESHOOTING

INTRODUCTION

THIS TROUBLESHOOTING SECTION IS PRESENTED AS AN AID TO ASSIST THE TECHNICIAN IN TROUBLESHOOTING PROBLEMS EXPERIENCED WITH THE PHACOEMULSIFIER. A TECHNICIAN SKILLED IN THE ART SHOULD DIAGNOSE ALL PROBLEMS USING STANDARD TROUBLESHOOTING METHODS. IN GENERAL, HOWEVER, IT IS RECOMMENDED THAT THE TECHNICIAN USE THE METHOD OF SUBSTITUTION OF ‘KNOWN GOOD’ COMPONENTS TO IDENTIFY MALFUNCTION.

PROBLEMS EXPERIENCED WITH THE PHACOEMULSIFIER CAN BE GROUPED IN THREE (3) CATEGORIES: PROBLEMS ASSOCIATED WITH THE SETUP OF THE SYSTEM, PROBLEMS WITH THE ACCESSORIES, AND FUNCTIONAL PROBLEMS WITH THE CONSOLE ITSELF. IT IS SUGGESTED THAT THE TECHNICIAN EVALUATE PROBLEMS ASSOCIATED WITH THESE THREE (3) GROUPS IN THE ORDER LISTED ABOVE.

NO USER SERVICEABLE COMPONENTS ARE CONTAINED WITHIN THE CONSOLE, AND SAFETY PRECAUTIONS DICTATE THAT INPUT POWER SHOULD BE DISCONNECTED FROM THE UNIT DURING SERVICING TO AVOID SHOCK HAZARD.

CONSIDERABLE CARE MUST BE EXERCISED WHEN PERFORMING TROUBLESHOOTING AND SERVICING TO AVOID THE INTRODUCTION OF ADDITIONAL PROBLEMS.

INADEQUATE VACUUM

INADEQUATE SUCTION (ASPIRATION) IN THE PHACO MODE IS USUALLY CAUSED BY AIR LEAKING INTO THE SYSTEM, REDUCING THE VACUUM LEVEL AT THE HANDPIECE. OTHER CAUSES OF REDUCED SUCTION INCLUDE:

- CLOGGED SYSTEM (TYPICALLY HANDPIECE ASPIRATION PASSAGEWAY)
- RATE KNOB SET TOO LOW
- U/S VACUUM KNOB SET TOO LOW
- VACUUM KNOB HAS BECOME UNCALIBRATED
- PUMP IS NOT RUNNING PROPERLY

IF, IN SURGERY, THE PUMP CONTINUOUSLY RUNS AT A REASONABLE SPEED, YET SUCTION IS INADEQUATE, AN AIR LEAK IN THE SYSTEM SHOULD BE SUSPECTED.

AIR LEAK TEST

1. LOAD AN AIR FILLED TUBING SET NORMALLY, INSURING THAT ALL FITTINGS ARE TIGHT AND THE PUMP ARM IS TIGHTLY LATCHED. THE HANDPIECE NEED NOT BE CONNECTED.

2. SET THE MODE SWITCH TO U/S, U/S VAC TO 120, RATE TO 40.

3. FULLY DEPRESS THE FOOTPEDAL. THE ASPIRATION PUMP SHOULD RUN CONTINUOUSLY.

4. PINCH OFF THE ASPIRATION TUBING AT THE HANDPIECE END. THE PUMP SHOULD STOP RELATIVELY QUICKLY AND REMAIN STOPPED FOR AT LEAST TEN (10) SECONDS.
   IF THE PUMP CONTINUES TO RUN, OR RAPIDLY STARTS AND STOPS, THERE IS AN AIR LEAK IN THE SYSTEM THAT IS RESPONSIBLE FOR A REDUCTION IN VACUUM LEVEL.

POSSIBLE SOURCES OF AIR LEAK

- TUBING BADLY WORN OR A CUT IN THE TUBING
- INCORRECT TUBING OR TUBING DIAMETER
- PUMP NOT ENGAGED OR TIGHTLY ADJUSTED
- LEAK IN THE CONNECTIONS (FITTINGS)
- LEAK INTERNAL TO CONSOLE

U/S VACUUM CALIBRATION (ZERO SHIFT) TEST

1. REMOVE THE TUBING AND THE FILTER FROM THE CONSOLE.

2. SET THE MODE SWITCH TO I/A, I/A VAC TO MINIMUM (0), RATE TO 40.

3. FULLY DEPRESS THE FOOTPEDAL. THE PUMP SHOULD IMMEDIATELY START TURNING AS THE I/A KNOB IS ADVANCED. THE ZERO VACUUM POINT IS MIS-CALIBRATED IF THE PUMP REMAINS STOPPED.

<u>INADEQUATE VENTING</u>

PULLING OF THE CAPSULE IS USUALLY EVIDENCE OF INCOMPLETE VENTING OF VACUUM UPON RELEASE OF THE FOOTPEDAL. UPON THE RELEASE, AIR IS INTRODUCED INTO THE ASPIRATION SYSTEM BY THE CONSOLE WHICH SHOULD THEN PASS THROUGH THE FRONT PANEL FILTER AND INTO THE ASPIRATION LINE.

IT IS RARE FOR PULLING OF THE CAPSULE, DUE TO INCOMPLETE VENTING, TO OCCUR IF THE TEST CHAMBER TESTS ARE PROPERLY PERFORMED BEFORE THE SURGERY. PLEASE REFER TO THE DGH 9000 DGH 9000 PHACO OPERATOR'S MANUAL P/N 897182, PAGES 20 TO 23, AND PAGES 30 TO 33. PER PAGES 20 AND 30: *"WARNING! ALWAYS PERFORM THE SYSTEM TEST IMMEDIATELY BEFORE USE ON A PATIENT*".

INADEQUATE VENTING IS USUALLY CAUSED BY AN OBSTRUCTION IN THE ASPIRATION SYSTEM. THE TWO MOST COMMON SITES ARE THE FRONT PANEL FILTER, AND THE HANDPIECE IN USE. MED TECH RECOMMENDS THAT THE FILTER BE CHANGED WITH EACH NEW SURGERY, ALTHOUGH MANY SURGEONS HAVE BEEN SUCCESSFUL WITH LESS FREQUENT REPLACEMENT. AT A MINIMUM THE FILTER SHOULD BE CHANGED AT THE BEGINNING OF EACH SURGERY DAY, OR IF ANY VENTING PROBLEMS DURING THE SYSTEM TESTS ARE EXPERIENCED. MED TECH DOES NOT SUPPLY TUBING KITS OR FILTERS. THE USUAL SOURCE FOR TUBING KITS AND THEIR ASSOCIATED FILTERS IS IPAX, INC. THEIR PART NUMBER 230T IS FOR THE DISPOSABLE TUBING KITS WITH FILTER INCLUDED. PLEASE CONTACT THEM AT 303-781-2444. REUSABLE TUBING KITS WITH SEPARATE FILTER ASSEMBLIES ARE ALSO AVAILABLE.

THE SECOND COMMON OBSTRUCTION SITE IS THE HANDPIECE IN USE. SHOULD THE ASPIRATION PATH BECOME CLOGGED, VACUUM RELEASE IS SLOWED TO THE POINT WHERE THERE IS NOT A COMPLETE RELEASE OF VACUUM AT THE HANDPIECE. THIS MOST COMMONLY HAPPENS IN THE NARROW PASSAGEWAYS OF THE I/A HANDPIECE. SHOULD A SURGEON EVER EXPERIENCE CAPSULE PULLING, THE VACUUM IN THE ASPIRATION LINE CAN ALWAYS BE RELEASED BY OPENING THE PERISTALTIC PUMP LATCH, OR BY REMOVING THE TEE FITTING FROM THE FILTER. IF THE VACUUM CAUSING PULLING IS NOT IMMEDIATELY AND COMPLETELY VENTED, THE HANDPIECE IS MOST CERTAINLY CLOGGED. AS THIS IS NOT A USUAL CONDITION, THE CLEANING PROCEDURE FOR THE HANDPIECES SHOULD BE REVIEWED.

IT IS POSSIBLE, THOUGH UNLIKELY, THAT THE DGH 9000-VENTING CYCLE MAY BE MALFUNCTIONING. SHOULD THIS BE SUSPECTED, PERFORM THE SYSTEM TEST (TEST CHAMBER TEST) USING A HANDPIECE THAT IS KNOWN TO BE FREE FROM DEBRIS AND UNCLOGGED, AND AN UNUSED FILTER. IF DEFLATION OF THE TEST CHAMBER IS EXPERIENCED, AND CANNOT BE CORRECTED BY NORMAL ADJUSTMENT OF THE IRRIGATION BOTTLE HEIGHT, A TECHNICIAN USING A VACUUM GAUGE SUBSTITUTED FOR THE HANDPIECE SHOULD TEST THE DGH 9000. IF VENTING TO ZERO VACUUM LEVEL IS NOT EXPERIENCED UPON RELEASE OF THE FOOTPEDAL, THE UNIT SHOULD BE RETURNED TO MED TECH FOR REPAIR AND CALIBRATION.

INADEQUATE U/S POWER

IN MANY CASES A GOOD U/S HANDPIECE OR A GOOD PHACO MACHINE CAN APPEAR BAD DUE TO PROBLEMS ASSOCIATED WITH A LOOSE PHACO TIP ATTACHED TO THE U/S HANDPIECE. UNDER THE SEVERE VIBRATION OF U/S POWER THE TIP CAN FUNCTION NORMALLY FOR A SHORT DURATION BEFORE THE TIP IS PARTIALLY LOOSENED BY THE VIBRATION.

PHACO TIPS ARE NORMALLY SUPPLIED IN TWO DIFFERENT MODELS. THE “SQUARE HUB” TYPE, AND THE “CONICAL HUB” TYPE THAT IS OFTEN REFERRED TO AS THE “STEALTH” TIP. THE “STEALTH” TIP IS DIFFICULT TO TIGHTEN. THE TOOL THAT IS SUPPLIED TO TIGHTEN THE “STEALTH” TIP HAS A SHORT LIFETIME, AND CAN BE DAMAGED AFTER ONLY ONE USE. THE RESULT OF THE USE OF A DAMAGED TOOL IS A PARTIALLY TIGHTENED TIP THAT WILL LOOSEN UNDER U/S POWER AND PRESENT THE SYMPTOM OF A BAD HANDPIECE OR PHACO MACHINE.

FOR PURPOSES OF TESTING, IT IS MUCH BETTER TO USE THE “SQUARE HUB” TYPE OF TIP. WHEN IN DOUBT OF THE QUALITY OF THE TIP-WRENCH, THE TIP CAN BE WELL TIGHTENED USING A PAIR OF PLIERS OR PERHAPS FORCEPS USING CARE NOT TO GRASP AND THEREFORE DAMAGE THE THIN-WALLED HANDPIECE CASE OR THE TIP ITSELF.

IF A KNOWN GOOD HANDPIECE AND PHACO MACHINE ARE AVAILABLE, THE BEST METHOD OF TROUBLESHOOTING IS TO EXCHANGE BACK AND FORTH BETWEEN THE KNOWN GOOD DEVICE AND THE SUSPECTED DEVICE.

TO TEST FOR A FAILED HANDPIECE, TIGHTEN A “SQUARE HUB” TIP TO THE SUSPECTED DEVICE. PREPARE A KNOWN GOOD HANDPIECE SIMILARLY. USING THE KNOWN GOOD PHACO MACHINE, EXCHANGE THE TWO HANDPIECES ON THAT PHACO MACHINE BACK AND FORTH ENOUGH TIMES TO VERIFY THAT THE PROBLEM FOLLOWS THE SUSPECTED DEVICE. TO PREVENT TIP RELATED PROBLEMS; ALWAYS RE-TIGHTEN THE TIP ON ANY HANDPIECE THAT APPEARS TO WORK IMPROPERLY. WHEN CHANGING HANDPIECES, ALWAYS TURN OFF THE PHACO POWER BEFORE THE CHANGE, AND ALWAYS HAVE THE REPLACEMENT HANDPIECE CONNECTOR PLUGGED INTO THE CONSOLE CONNECTOR BEFORE APPLYING POWER AT THE REAR PANEL POWER ON/OFF ROCKER SWITCH.

TO TEST FOR A FAILED PHACO MACHINE, THE PROCESS IS VERY SIMILAR. THIS TIME ONLY THE KNOWN GOOD HANDPIECE IS USED. EXCHANGE THAT HANDPIECE BACK AND FORTH BETWEEN MACHINES ENOUGH TIMES TO VERIFY THAT PROBLEMS ARE ONLY OCCURRING WITH THE SUSPECTED MACHINE. AS ABOVE, RE-TIGHTEN THE PHACO TIP AS REQUIRED TO VERIFY TIGHTNESS.

IN BOTH CASES, IT IS IMPORTANT TO RE-TEST THE COMBINATION THAT INITIALLY WAS WORKING TO INSURE THAT SOME TYPE OF FAILURE OR ERROR HAS NOT OCCURRED DURING THE MIDDLE OF TESTING.

USER SERVICEABLE PROBLEMS

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
INCOMPLETE VENTING	CLOGGED FILTER	REPLACE FILTER
	CLOGGED HANDPIECE	INSPECT AND CLEAN HANDPIECE
	CLOGGED ASPIRATION TUBING	INSPECT AND CLEAN TUBING
INADEQUATE VACUUM	AIR LEAK IN ASPIRATION CIRCUIT	INSPECT TUBING FOR CUTS TIGHTEN ALL ASPIRATION FITTINGS
	INADEQUATE PERISTALTIC PUMPING ACTION	CHECK THAT PUMP LATCH IS TIGHT
	INADEQUATE TUBING COMPRESSION	ADJUST COMPRESSION VIA PUMP SETSCREW REPLACE PUMP HEAD ASSEMBLY REPLACE WORN TUBING
INADEQUATE FLOW	WORN, COLLAPSED TUBING	REPLACE TUBING
VACUUM EXCEEDS PRESET LIMIT	EXCESSIVE FLOW RATE	REDUCE RATE SETTING
PARTIAL CHAMBER COLLAPSE UPON OCCLUSION BREAKAGE	EXCESSIVELY HIGH U/S VACUUM	REDUCE U/S VACUUM SETTING
	LOW IRRIGATION SYSTEM PRESSURE	RAISE IRRIGATION SOLUTION CONTAINER
	ASPIRATION TUBING CAUSING SURGE	USE SMALL DIAMETER U/S ASP TUBING SET DESIGNED FOR U/S VACUUM > 80 mmHg
U/S POWER WEAK	LOOSE U/S TIP	TIGHTEN TIP/ REPLACE WORN TIP WRENCH
	U/S HANDPIECE AT END OF LIFE	REPLACE WITH NEW U/S HANDPIECE

USER SERVICEABLE PROBLEMS

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
NO SURGEON CONTROL	CONTROL SWITCH IN PANEL POSITION	SET CONTROL SWITCH TO SURGEON
NO AUDIO FEEDBACK OF	VOLUME CONTROL SET TO MINIMUM	ADVANCE VOLUME VACUUM CONTROL KNOB
NO DISPLAYS LIT, NOT FUNCTIONAL	LOOSE OR FAILED POWER CORD	RESEAT/REPLACE POWER CORD

INTERNAL SYSTEM FAILURES

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
SYSTEM DOES NOT RESPOND PROPERLY TO FOOTPEDAL	FOOTPEDAL BAD	REPLACE FOOTPEDAL
	CONNECTOR ON AUDIO/VAC ASSY DAMAGED	REPLACE AUDIO/VAC ASSEMBLY
PERISTALTIC PUMP DOES NOT ROTATE PROPERLY	WORN PUMP GEARTRAIN	REPLACE PUMP MOTOR
NO PNEUMATIC PRESSURE IN VIT MODE	FAILED COMPRESSOR	REPLACE VIT MODULE
	FAILED SOLENOID	REPLACE VIT MODULE
NO CAUTERY OUTPUT	SHIPPING DAMAGE TO CAUTERY	REPLACE U/S CONTROLLER
NO AUDIO FEEDBACK VARIATION WITH VACUUM	FAILED AUDIO/VAC ASSEMBLY	REPLACE AUDIO/VAC TONE ASSEMBLY
POWER SWITCH/BREAKER REPEATEDLY TRIPS	FAILED POWER SUPPLY	REPLACE POWER SUPPLY
NO FUNCTIONS	FAILED POWER SUPPLY	REPLACE POWER SUPPLY

<u>INTERNAL SIGNALS</u>

CONN/PIN	SIGNAL	M'MENT (V)	CONDITION	DESCRIPTION
J1 - 1	PSRTN	0.0	ALL	POWER SUPPLY RETURN (PSRTN)
2	+24V	+25V	ALL	+25V POWER INPUT
3	PSRTN	0.0	ALL	POWER SUPPLY RETURN (PSRTN)
4	+12V	+12V	ALL	+12V POWER INPUT
5	+5V	+5V	ALL	+5V POWER INPUT
6	-12V	-12V	ALL	-12V POWER INPUT
7	-5V	-5V	ALL	-5V POWER INPUT
8	PSRTN	PSRTN	ALL	POWER SUPPLY RETURN
J2 - 1	USHI	3.0	SURGEON MODE	OUTPUT TO U/S POWER CONTROL
		0.0		PANEL MODE, PEDAL RELEASED
		3.0		PANEL MODE, PEDAL FULLY DEP
2	USVACLO	0.0	ALL	REF GND TO U/S VAC CONTROL
3	USW	0.0	U/S POWER = 0%	INPUT FROM U/S POWER CONTROL
		3.0	PANEL MODE, U/S POWER = 100%	
		0.0 - 3.0	SURGEON MODE, U/S POWER = 100%	IS 3.0V X FOOTPEDAL X U/S POWER
4	USVACW	0.0	U/S VAC = 0 mmHg	INPUT FROM U/S VAC CONTROL
		0.5	U/S VAC = 100 mmHg	U/S LO VAC
		1.0	U/S VAC = 200 mmHg	U/S HI VAC
5	USLO	0.0	ALL	REF GND TO U/S POWER CONTROL
6	USVACHI	5.0	ALL	REF FOR US VAC CONTROL
7	RATEHI	5.0	IRR & U/S MODES	OUTPUT TO RATE CONTROL
		5.0	PANEL, I/A & VIT MODES	
		0.0 - 5.0	SURGEON, I/A & VIT MODES	IS 5.0V X FOOTPEDAL
8	VITHI	4.3	ALL	INPUT TO VIT CONTROL
9	RATEW	1.4 - 5.0	IRR & U/S MODES	INPUT FROM RATE CONTROL
		1.4 - 5.0	PANEL, I/A & VIT MODES	
		0.0 - 5.0	SURGEON, I/A & VIT MODES	
10	VITW	4.3	VIT = 0 CUTS/MIN	INPUT FROM RATE CONTROL
		3.4	VIT = 600 CUTS/MIN	
11	RATELO	1.4	IRR & U/S MODES	RETURN FOR RATE CONTROL (3.9k TO GND)
		1.4	PANEL, I/A & VIT MODES	
		0.0 - 1.4	SURGEON, I/A & VIT MODES	
12	VITLO	3.4	ALL	RETURN FOR VIT CONTROL
13	CAUTHI	5.0	ALL	OUTPUT TO CAUT CONTROL
14	IRR*	0.0	IRR MODE	MODE SWITCH IRR POSITION OUTPUT
		5	I/A, U/S, VIT MODES	
15	IAVACHI	5.0	ALL	OUTPUT TO I/A VAC CONTROL
16	IA*	0.0	I/A MODE	MODE SWITCH I/A POSITION OUTPUT
		5	IRR, U/S, VIT MODES	
17	IAVACW	0.0	I/A VAC = 0 mmHg	INPUT FROM I/A VAC CONTROL
		5.0	I/A VAC = 500 mmHg	

CONN/PIN	SIGNAL	M'MENT (V)	CONDITION	DESCRIPTION
J2 - 18	USSTD*	0.0	US STD MODE (NON-PULSE)	MODE SWITCH U/S POSITION + PULSE SWITCH @ NON-PULSE
		5	ALL EXCEPT US STD MODE	
19	IAVACLO	0.0	ALL	RETURN FOR IAVAC POT
20	USPLSE*	0.0	U/S PULSE MODE	MODE SWITCH U/S POSITION + PULSE SWITCH @ PULSE
		5.0	ALL EXCEPT U/S PULSE MODE	
21	CAUTW	0.0 - 5.0	ALL	INPUT FROM CAUTERY CONTROL
22	VIT*	0.0	VIT MODE	MODE SWITCH VIT OUTPUT
		5.0	ALL OTHER MODES	
23	CAUTLO	0.05ALL		RETURN FOR CAUTERY POT
24	PSRTN	0.0	ALL	POWER SUPPLY RETURN
25	+5V	5.0	ALL	+5V POWER TO FRONT PANEL BOARD
26	PSRTN	0.0	ALL	POWER SUPPLY RETURN
J3 - 1	SWCOM	0.0	ALL	CONTROL SWITCH COMMON (PSRTN)
2	VPEDALHI	5.0	ALL	+5.0V REFERENCE OUTPUT TO FOOTPEDAL
3	VPEDALRTN	0.0	ALL	RETURN FOR FOOTPEDAL POT
4	REFLUX*	4.2	REFLUX SWX RELEASED	OUTPUT FROM FOOTPEDAL REFLUX SWITCH
		0.0	REFLUX SWX DEPRESSED	
5	NO CONNECTION			
6	NO CONNECTION			
7	VACACT	0.0	0 mmHg MEASURED VACUUM	OUTPUT FROM VACUUM TRANSDUCER
		2.50	500 mmHg MEASURED VACUUM	
8	VPEDAL	0.0	FOOTPEDAL RELEASED	OUTPUT FROM FOOTPEDAL TREADLE POT
		5.0	FOOTPEDAL FULLY DEP	
9	+12V	12	ALL	+12V POWER TO AUDIO VAC
10	GFAULT	0	HANDPIECE GROUND OK	GROUND FAULT SIGNAL (NOT USED)
		5	HANDPIECE GROUND OPEN	
11	SW2	0	FOOTPEDAL RELEASED	FOOTPEDAL CONTROLLED ASP/VIT ENABLE
		4.5	FOOTPEDAL PAST DETENT 1	
12	CASE	0	ALL	CHASSIS GROUND
13	SURG*	0	SURGEON MODE	OUTPUT FROM CONTROL SWITCH
		5	PANEL MODE	
14	CAUT*	5	CAUTERY SWITCH RELEASED	OUTPUT FROM FOOTPEDAL CAUT SWITCH
		0	CAUTERY SWITCH DEPRESSED	

CONN/PIN	SIGNAL	M’MENT (V)	CONDITION	DESCRIPTION
J4 - 1	+12V	12	ALL	+12V POWER TO XDUCER/VENT
2	+5V	5	ALL	+5V POWER TO XDUCER/VENT
3	-5V	-5	ALL	-5V POWER TO XDUCER/VENT
4	PSRTN	0	ALL	POWER GROUND RETURN
5	PSRTN	0	ALL	POWER GROUND RETURN
6	SW2	0	FOOTPEDAL RELEASED	FOOTPEDAL CONTROLLED ASP/VIT ENABLE
		4.5	FOOTPEDAL PAST DETENT 1	
7	+5.0V	5.0	ALL	+5.0V REFERENCE TO XDUCER
8	RTN	0.0	ALL	REFERENCE GROUND FOR XDUCER
9	IRRB*	0	IRR MODE	INHIBITS VENT IN IRR MODE
		5	ALL EXCEPT IRR MODE	
10	VACACT	0.0	0 mmHg MEASURED VACUUM	OUTPUT FROM VACUUM TRANSDUCER
		2.50	500 mmHg MEASURED VACUUM	
J5 - 1	HNDPCEHI	0	U/S POWER = 0%	U/S POWER OUTPUT TO U/S HANDPIECE
		1000 P-P	U/S POWER = 100%	40 kHz SINE WAVE
2	NO CONNECTION			
3	HNDPCELO	0	ALL	RETURN FOR U/S HANDPIECE
4	NO CONNECTION			
J6 - 1	IRRSOL1	0	IRR SOLENOID RELEASED	IRR SOLENOID RETURN
		1.5	IRR SOLENOID ENERGIZED	
2	IRRSOL2	0	IRR SOLENOID RELEASED	IRR SOLENOID POWER
		-1, 24	IRR SOLENOID ENERGIZED	24V INITIAL RECT WAVE 122 uS/12 uS ON/OFF
J7 - 1	ISQ	0,12	TEST SIGNAL, CURRENT PHASE	SQ WAVE, 40 kHz
2	ESQ	0,12	TEST SIGNAL, VOLTAGE PHASE	SQ WAVE, 40 kHz
3	RTN	0	ALL	RETURN FOR TEST SIGNALS
4	ERRAMP	3 - 10	U/S DRIVER ENABLED AND TUNED	FREQ CONTROL VOLTAGE
5	EVARB	2.3	U/S POWER = 10%	DC POWER TO U/S DRIVER
		23	U/S POWER = 100%	

CONN/PIN	SIGNAL	M'MENT (V)	CONDITION	DESCRIPTION
J8 - 1	+12V	12	ALL	+12V POWER TO VIT
2	PSRTN	0	ALL	POWER GROUND RETURN
3	NO CONNECTION			
4	NO CONNECTION			
5	NO CONNECTION			
6	RTN	0.0	ALL	REFERENCE GROUND FOR VIT
7	VITENB*	5	VIT DISABLED	VIT ENABLE VIT MODE + DETENT 1
8	NO CONNECTION			
9	NO CONNECTION			
10	VITHI	4.3	ALL	OUTPUT TO VIT CONTROL
11	VITW	4.3	0 CUTS/MIN	INPUT FROM VIT CONTROL
		3.4	600 CUTS/MIN	
12	VITLO	3.4	ALL	VIT CONTROL RETURN
13	+5V	5	ALL	+5V POWER TO VIT
14	PSRTN	0	ALL	POWER GROUND RETURN
15	PSRTN	0	ALL	POWER GROUND RETURN
16	+24V	24	ALL	+24V POWER TO VIT
17	+24V	24	ALL	+24V POWER TO VIT
18	+24V	24	ALL	+24V POWER TO VIT
19	NO CONNECTION			
20	NO CONNECTION			
J9 - 1	MTR1	0	ALL	MOTOR RETURN
2	MTR2	4 - 7	MOTOR MINIMUM RPM	POWER TO MOTOR
		14 - 20	MOTOR MAXIMUM RPM	
		-6	MOTOR REVERSED (REFLUX)	
3	TACH1	0	ALL	TACHOMETER RETURN
4	TACH2	-4	MOTOR MINIMUM RPM	OUTPUT FROM TACHOMETER
		-14	MOTOR MAXIMUM RPM	
J10 -1	CAUT1	150 P-P, 1 MHz	CAUTERY MAXIMUM	TERM 1 OF BIPOLAR CAUT
		0	CAUTERY MINIMUM	
2	NO CONNECTION			
3	CAUT2	BIPOLAR		TERM 2 OF BIPOLAR CAUT

CONN/PIN	SIGNAL	M'MENT (V)	CONDITION	DESCRIPTION
P50 -1	+12V	12	ALL	+12V POWER TO FRONT PNL
2	USHIC	3.0	PANEL MODE	OUTPUT TO U/S POWER
		0.0 - 3.0	SURGEON MODE	CONTROL
3	VPEDALBB	0.0 - 3.0	ALL	OUTPUT FROM FOOTPEDAL TREADLE POT
4	USREF	0.12	ALL	REFERENCE THRESHOLD TIMER ENABLE
5	USPLSE	5	U/S PULSE ENABLE	MODE SWITCH U/S POSITION + PULSE
		0	ALL OTHER MODES	
6	USSTD	5	U/S STANDARD (NON-PULSE)	MODE SWITCH U/S POSITION + PULSE SWITCH @ NON-PULSE
7	IAVAC/USVAC	0.0 - 2.5	I/A, VIT MODES	VACUUM LIMIT PRESET VOLTAGE
		0.0 - 0.5	U/S LO VAC MODE	
		0.0 - 0.25	U/S HI VAC MODE	
8	VACACT	0.0	0 mmHg MEASURED VACUUM	OUTPUT FROM VACUUM TRANSDUCER
		2.50	500 mmHg MEASURED VACUUM	
9	POS2	0	FOOTPEDAL RELEASED	VAC METER PRESET/ACTUAL SWITCHING
		4.5	FOOTPEDAL PAST DETENT 1	
10	3.0V	3.0	ALL	+3.0V REF OUTPUT TO FRONT PANEL
11	-5V	-5	ALL	-5V POWER TO FRONT PANEL
12	RTN	0.0	ALL	REFERENCE GROUND FOR FRONT PANEL